Playing with Tiles
Beginning to Tessellate

R.GOMATHY

Many people are of the opinion that mathematics is only about numbers and number operations, and thus myths related to who can do mathematics and who cannot, abound. It is possible that children may struggle with numbers, but it is hard to believe that there could be a child who doesn't recognize patterns. We see children creating patterns all the time using stones, sticks, leaves, flowers, finger prints, vegetable carvings, rubber stamp impressions and also mathematical shapes. Often they create patterns unknowingly as part of their games and activities. Children should look for patterns as a means of understanding and learning mathematics. "Looking for patterns trains the mind to search out and discover the similarities that bind seemingly unrelated information together as a whole…. A child, who expects things to make sense, looks for the sense in things and from this sense develops understanding. A child who does not see patterns often does not expect things to make sense and sees all events as discrete, separate and unrelated." (Baratta, as cited in Burns, 112)[1]



The word 'Tessellation' comes from the Latin word *'tessella'* which means a small cube or a tile. When we say tessellation, we mean filling a surface or a plane with flat shapes without any gaps or overlap. So it may also be called as a pattern of shapes that fit perfectly together.

Keywords: tessellation, pattern, play, tiles, colour, shape

In this article I (a primary school teacher) wish to share the experiences when my Grade III students engaged with a two-dimensional patterning exercise, called Tessellation or Tiling.

Let me introduce my students to you. We belong to a small school in Puducherry and I teach them Language (English), Mathematics and EVS. The students mentioned in this article are of age group seven- eight years. Ours is a small classroom (22 by 22 feet) but I manage to maintain a mathematics corner, equipped with lots of manipulatives, in our small room. To state some, we have material for learning counting, place value, four basic arithmetic operations, and fractions. Both teacher and students take joint responsibility of arranging and maintaining these materials.

The beginning

Many good examples of tessellations can be located in historical monuments but as my students could not be taken to these sites, I planned to show them the examples of tessellations from our easily available resources, such as the pathway of Bharathi Park in Puducherry, veranda grills of our houses, window designs in the church and the tiles in kitchens and restrooms of houses and schools, and of course, tiling patterns in the children's dress materials.



Bharathiyar Park


Ashram


Walking path on the beach

In our syllabus, tiling patterns are introduced from Class II onwards. Since last year, I give tessellation activities to Grade II children. However, this year while doing the activities on tessellations, I noticed a huge difference in the approach of the children.




St. Angel Church, Puducherry

Grade II generally regarded this activity as a 'fun activity,' mainly associating it with their prior experiences of making kolams and other floor designs. This year, I noticed that as these children moved to Grade III, their approach started becoming more mathematical. This was evident from the way they had started using mathematical terms while doing the tessellation activities. I observed them using words such as 'square', 'triangle', 'hexagons', 'sides (edges)', 'corners(vertices)', 'tiling', and 'gaps' more often. One could see an emergence of mathematical maturity as they used mathematically-oriented vocabulary. Using precise mathematical terms reflected their connection with the concepts.

Moving on… Engaging and learning

In this section, Grade III children's journey of learning tessellations has been shared. We began with 'completing the pattern' exercise and gradually moved to learning about tiling two-dimensional shapes.

Completing the pattern:

All pattern related exercises begin with the task of completing a given incomplete pattern. This exercise acquaints children with the intricacies of placing the units correctly. I knew that my Grade III children were already familiar with creating linear patterns; this time I gave them an activity to complete a pattern involving two-dimensional shapes. To give them a hint, an example of tessellation pattern was displayed in front of the class and the children were asked to first copy and then complete the pattern in the worksheet given to them.

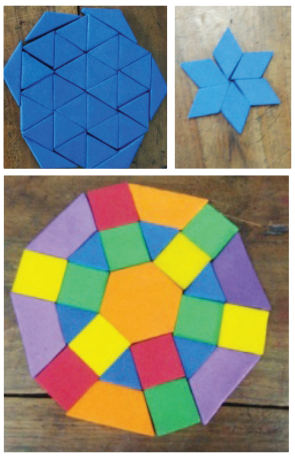
Based on their work, I could easily place the children under three categories.

1. Children who could complete the pattern as expected. Only 4 children were able to continue the tessellation pattern as expected.
2. Children who could complete the pattern partly. These children did make a pattern based on their own ideas but their work was different from what was expected. I could place 8 children in this category.
3. Children who did not work on expanding the pattern and instead took it as a 'fun activity' of colouring. Three children were seen taking it as a colouring activity.

After completing the pattern, the students were given space to explain their thoughts. This discussion helped children identify the mistakes they had made and to also reflect on how they had understood/misunderstood the activity.

Understanding the basics of Tessellation:

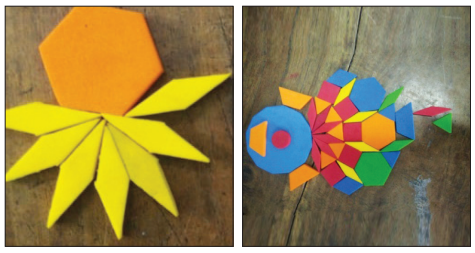
Next, we moved on to learning the basics behind tessellations. We used some geometrical shapes from the tessellation kit available in our mathematics corner. I divided the class into three groups with five children in each group and they were asked to use the shapes from the kit and fill up the top surface of the table in such a way that there were no gaps or overlaps between the shapes. Examples of the floor tiling patterns which we had identified earlier in and around our Puducherry city were shared. Each group worked to make their tiling patterns.



Preliminary engagement

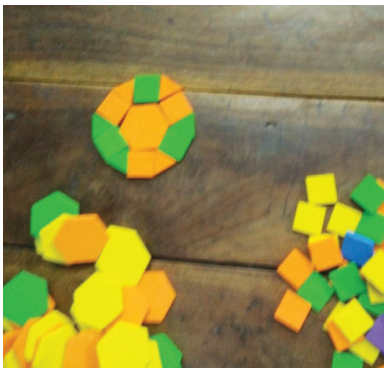
Complex patterns

After this activity I wanted to categorise the students based on their level of understanding of the concept. Some children could work only to a preliminary level while some understood the idea and made complex tessellation patterns. As one can see, children at preliminary level were those who placed the shapes edge-to-edge with no gaps and no overlaps but were unable to proceed with the same pattern throughout.



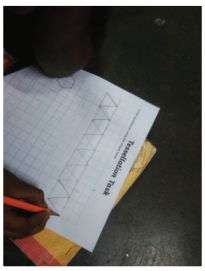
While doing this activity, the children also learnt about the idea of rotational symmetry, particularly of square, equilateral triangle and regular hexagon. I asked the children to rotate these shapes and see if the orientation of these shapes changed after undergoing a rotation of 180 degrees. Children articulated that 'square remains the same, likewise hexagon also remains the same, but the triangle turns upside down.' They used their own informal language (in Tamil, which is their mother tongue) to express this.

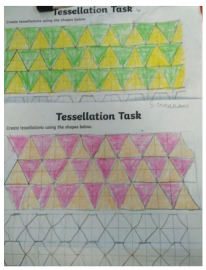
Afterwards, the children started their work on creating a tiling pattern but this time I had to facilitate their working. I gave triangles and squares to one group, hexagons and triangles to the second group, and hexagons, triangles and squares to the third group. Their task was to create a tiling pattern with the shapes given to them.



Initially, the children got attracted to the colours of the tiles and did not bother to place them in a tessellation network. One could see gaps between the tiles and there was no specific pattern in their work. I had to remind them of their earlier learnings and soon after the children refined their work and created some tiling patterns.

Then I gave them some square-grid sheets and asked them to draw their respective tessellations. I could see the children were ready to handle the complexities of creating tiling patterns on the square-grid sheets. They showed remarkable improvement.





Some reflections

At times, students find it difficult to imagine things. Often they need additional support in doing so and in such situations concrete material does the scaffolding. I am reminded of Cobb & Bowers's (1999)[2] thoughts, "Vygotsky took interest in the fact that human action is mediated by tools and signs. He says that tools could be physical or psychological. Researchers says that

tools have profound influence on mathematical thinking and the way students develop mathematical understanding." Connecting with my work, I can say, the colourful tessellation kit helped my children understand the concept of tessellations. My children of class III were beginners to the tessellation activity; therefore I had to use the tessellation and 'rangometry' kits. In the Class III textbook, tiling activity is confined only to a colouring activity and children find it very difficult to imagine the symmetrical and rotational patterns from the textbook. When they handle the pieces of the kit, they feel motivated to do the activity. The physical touch of the shapes also familiarizes them to the properties of the shapes.

I also noticed that students find tessellations with hexagons and triangles easiest. Rarely did they try their hands on tessellating regular triangles and squares. This may be because of the influence of drawing *Kolam and Rangoli* designs in their houses. One of the girls, Rohini, said that she could make very attractive designs as she helps her mother in making *Kolam* designs. Many other girls shared similar experiences.

Another important observation is that the children in Class III were not interested in tiling the entire surface. They rather preferred making shapes of house, boat, flower pots and *Rangoli* designs. This shows that students keenly observe their surroundings and are very attached to their environment. Some of the girls, instead of making two dimensional tiles, began stacking the shapes. On asking, they said they liked to construct buildings using those tiles. Was this due to their prior experience of playing with the building blocks, I wonder.

According to the learning outcomes of the NCERT, by the time children reach Class III, they must be able to create and expand patterns. This tessellation activity was helpful as, through it, my Class III students were able to visualize and handle the shapes and deduce their properties. I am confident that this foundational activity will help my children understand geometry in a better way. I could see them recognizing and explaining the properties of shapes. They were making intricate monohedral tiling patterns with regular polygonal tiles. Although these concepts are not dealt with in detail in NCERT Class III textbook, my students were doing this intuitively. They could see rotational symmetry in shapes, recognize and describe the properties of regular shapes, and could appreciate the aesthetic aspect in mathematics.

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References

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2] http://archive.dimacs.rutgers.edu/nj_math_coalition/fwfinal/ch11/ch11_k-02.html

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